High School Science
Agri-biology

Agribiology for the Life Science component within the Science requirement

Course Overview:
This one-credit course uses agricultural contexts to present the life science content outlined in the *Program Studies*. As students study practical agricultural concepts, they apply scientific ways of thinking and working to real-life problems. During their study of agri-biology, students perform many practical tasks. They create models, extract DNA, analyze DNA fingerprints, construct tables and graphs to classify and analyze data, and test soils. Students also participate in cooperative and collaborative groups, use technology to solve problems, and participate in field trips to apply scientific concepts to agricultural and environmental problems. Students develop an understanding of many concepts such as cell structure and function, morphology and physiology of agriculturally significant animals, heredity principles and inheritance patterns, genetic engineering, animal behavior, biological change, interdependence of plants and animals, and the flow of matter and energy through ecosystems.

Models are organized around guiding questions. Guiding questions (in bold print) direct teachers' choices of activities and are the questions students should be able to answer at the end of the course. Essential questions may be included to further focus student learning.

Pages of models are arranged in pairs. On the left-hand page of each pair are guiding (in bold print) and essential questions along with related academic expectations and correlation to the and agri-biology content chart. Sample activities and sample extensions for diverse learners are found on the right-hand page. While sample activities address content or content from elective areas, they are not intended to be comprehensive. Teachers still are responsible for planning instruction to meet the diverse needs of all their students.

Guiding and Essential Questions:
How do cell structure, function, and processes affect living things?

What is the molecular basis of heredity?

• How does DNA affect organisms' morphology and physiology?

How do behavioral patterns ensure reproductive process?

• How do agriculturalists manipulate reproductive success?

What are the processes of biological change?

• How do agricultural crops and animals reflect diversity in nature?

How are organisms within ecosystems interdependent?

• How do agricultural processes alter ecosystems?

• How are croplands different from natural ecosystems?

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How do organ systems work together to keep animals healthy?

What skills and knowledge must I have to be successful in an agricultural career in Kentucky?

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Academic Expectations	Guiding Questions	Correlations to the Program of Studies
Scientific Ways of Thinking and Working, Patterns, Systems, Scale and Models, Constancy, and Change Over Time (2.1 - 2.6)	How do cell structure, function, and processes affect living things?	**Students will** **Life Sciences** • investigate cell structures and their functions. • investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems. • investigate photosynthesis, cellular respiration, and energy. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • analyze how science and technology are necessary for solving issues. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • communicate recurring themes and processes of biology and chemistry that are common to all organisms. • relate fundamentals of genetics to organisms' morphology, physiology, and inheritance patterns.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • examine slides of various cell types from multicellular organisms. Discuss relationships between structure of different cell types and their functions. Determine common structures and functions of all cells. Create models of plant and animal cells, using biodegradable materials. Label and color code each organelle and describe its function. Identify organelles common to both and unique to each. • compare functions of cell organelles to school or city structures that have similar functions. Create multimedia presentations showing comparisons. • investigate use of microbes to produce substances needed by other plants, animals, and humans (e.g., insulin). Create illustrated flow charts, demonstrating processes. Write editorials, explaining need for increased funding for basic research in microbiology. *Use this activity to develop possible writing portfolio entries (WP - Transactive).* • research use of biotechnology and genetic engineering in development of new livestock breeds, plants, and disease control. Evaluate alternatives to genetic engineering methods. Evaluate impact of genetic engineering on their community and predict short- and long-term consequences. Develop policies that regulate use of genetic engineering. Present findings and recommendations to agricultural extension agents. ***Technology suggestion:*** *Use CD-ROMs, digital cameras, computers, video, and audio to create multimedia presentations for extension agents.* • investigate how and when cells differentiate. Read "How Does a Single Cell Become a Whole Body." Trace formation of germ layers and identify organ systems that develop from each layer. Create informational bulletin boards, collages, or posters to display in classrooms.	

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Scientific Ways of Thinking and Working, Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	How do cell structure, function, and processes affect living things?	**Students will** **Life Sciences** • investigate cell structures, and their functions. • investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • analyze how science and technology are necessary for solving issues. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • communicate recurring themes and processes of biology and chemistry that are common to all organisms. • relate fundamentals of genetics to organisms' morphology, physiology, and inheritance patterns.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • observe chicken embryos at 24, 48, and 72 hours of development. Record observations throughout incubation period, including humidity, temperature, turning rate, weight, and stage of maturity. Compare in graphic organizers features at different stages. Identify body structures of developing embryos and explain their functions. Investigate factors that interfere with embryonic development. Create multimedia presentations for poultry farmers to explain embryonic development. • investigate prenatal and postnatal growth and development. Compare growth rate of organ systems after animals are born. Write summaries in learning logs, describe growth rates of different organ systems and effect growth rate has on animals.	Julie needs to develop confidence in her ability to contribute positively in class. Her family owns and manages a poultry industry. Julie will arrange for her class to visit and observe the chick incubation and hatching process (*Types of extensions: motivation, participation).*

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Academic Expectations	Guiding Questions	Correlations to the Program of Studies
Scientific Ways of Thinking and Working, Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**What is the molecular basis of heredity?** How does DNA affect organisms' morphology and physiology?	**Students will** **Life Sciences** • investigate DNA. • investigate encoding and replication. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • explore the impact of science on personal and community health. • analyze how science and technology are necessary for solving issues. • analyze the role science plays in everyday life and compare different careers in science. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • relate fundamentals of genetics to organisms' morphology, physiology, and inheritance patterns. • compare anatomy, breeding, and reproduction of animal species.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • examine structure of DNA. Extract DNA from onion cells to observe color, texture, and thread-like structure. Construct models of DNA molecules and show locations of genes. Display models in science labs. Write articles for school newspapers concerning future applications of information derived from the Human Genome Project (*WP - Transactive*). • research use of DNA fingerprinting in food and animal science. Run DNA fingerprinting through electrophoresis to show how DNA fragmentation analysis can be used for identification. Create multimedia presentations explaining how public health safety workers track spread of bacteria (e.g., Listeria) and other pathogens. Explain procedure and results in learning logs. • read Watson's account of his discovery of DNA structure. Summarize method used and evidence gathered. Investigate lives of other researchers who were involved in discovery (e.g., Francis Crick, Rosalind Franklin, Maurice Wilkins). Write resumes for each researcher. • examine replication. Use models of DNA molecules to show how one DNA molecule can form exact duplicate of itself. • investigate protein synthesis, including transcription and translation. Explore evolutionary significance of common genetic language. Create models to demonstrate process. • distinguish between simple Mendelian inheritance (e.g., coat color in rabbits), multiple allelic inheritance, and polygenic inheritance (e.g., cob length in corn). • create hypothetical corn plants, using different colored paper clips for traits (e.g., height, leaf color, seed color). Record phenotypes and genotypes in learning logs. Investigate traits controlled by extranuclear DNA (e.g., mitochondrial). Determine inheritance patterns in plants (e.g., variegated leaf trait of Brassica rapa). Write feature articles for agricultural journals explaining differences in inheritance patterns (*WP - Transactive*). • study family relationships of livestock, using phenotypic records extending over two or more generations. Choose traits (e.g., dwarfism in Hereford cattle) and gather information about traits ancestors exhibited to complete pedigrees. Use Punnett squares to determine apparent inheritance patterns for that trait.	Betty and Agnes already have an understanding of DNA as it applies to genetics. They will use the Internet and other sources to discover new or potential uses for DNA technologies. They will communicate with forensic medicine specialists about their findings and create presentations to share with their class (*Types of extensions: magnitude, motivation, resources and materials, complexity*). Bryan and Melissa are able to learn with their peers, but have difficulty following directions. They will pair with classmates to investigate phenotypic and genotypic inheritance patterns (*Types of extensions: complexity, resources and materials*).

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Sample Activities	Sample Extensions for Diverse Learners
Students will • use sire summaries to distinguish between performance testing and progeny testing. Examine copies of pedigree papers of several animals of same breed. Compare animals based on pedigrees and performance records. Develop reports for agricultural advisory committees on beef breed improvement in their county. Investigate benefits of hybrid vigor. • research physical characteristics of economically important agricultural animals (e.g., sheep, cattle, swine). Determine whether traits are influenced more by genetics or environment. • obtain copies of dairy cattle sire catalogs and lineage classification data from dairy herds. Using data on females from herd records and data on sires from catalogs, choose most desirable sires for cows in that herd. Write introductions for catalogs describing how the information contained within can be used to improve herd quality *(WP - Transactive).*	

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Scientific Ways of Thinking and Working, Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**How do behavioral patterns ensure reproductive success?** How do agriculturalists manipulate reproductive success?	**Students will** **Life Sciences** • investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems. • investigate behavioral responses. • analyze patterns of behavior. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • analyze how science and technology are necessary for solving issues. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • compare anatomy, breeding, and reproduction of animal species. • identify functions of plant structures. • identify environmental factors that affect crop production.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • investigate life cycle of flowering plants. Create models, bulletin boards, or collages demonstrating cycles. Label all plant parts and describe function. Summarize in learning logs why knowledge of plant life cycles is important to agriculturalists. • investigate various forms of pollination (e.g., wind, water, insect). Create charts to compare forms of pollination in plant families. Investigate coevolution between plants and pollinators. Design and conduct investigations to determine effects of absence of pollinators on plant reproduction. Research use of bees as pollinators and diseases that have reduced bee populations. Write articles for agricultural journals explaining impact of reduced bee populations on crops *(WP - Transactive).* • investigate reactants and products of photosynthetic chemical reaction. Use light screens on Geranium leaves. Conduct iodine tests after several days to determine effects of light and absence of light on production of carbohydrates in leaves. Place *Elodea* plants into carbonate solutions under bright light. Count oxygen bubbles as they emerge from cut ends of *Elodea* plants. Analyze activities and produce an empirical word equation for photosynthetic chemical reaction. Investigate ways to increase or decrease rate of oxygen production. Compare photosynthesis in plants adapted to life in arid conditions with plants growing in Kentucky. • investigate vegetative propagation (e.g., rhizomes, stolens, tubers, grafting). Compare advantages and disadvantages to plants and humans of vegetative propagation over sexual reproduction. Propagate different species of plants in class and compare results. Distribute plants at parents' night. • research behaviors (e.g., social, reproductive, feeding) of agricultural animals. Determine how livestock producers deal with animal behaviors (e.g., feeding schedules, facility designs). Observe flock or herd animals, listing observed behaviors and determine which behaviors are instinctive and which are learned. Shadow county extension agents or veterinarians to determine how agriculturalists deal with problems related to livestock behaviors.	

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Scientific Ways of Thinking and Working, Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**How do behavioral patterns ensure reproductive success?** How do agriculturalists manipulate reproductive success?	**Students will** **Life Sciences** • investigate behavioral responses. • analyze patterns of behaviors. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • analyze how science and technology are necessary for solving issues. • recognize that scientific knowledge subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • compare anatomy, breeding, and reproduction of animal species. • identify functions of plant structures. • identify environmental factors that affect crop production.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • compare size and shape of sperm and egg cells of animal species. Check semen samples under microscopes for motility. Determine if any sperm cells are abnormal. Observe color, mobility, progressiveness, and abnormalities (e.g., tailless, two tails, two heads, pear-shaped heads). Examine prepared slides of ovary. Sketch ovary, including mature follicles and eggs. Prepare lab reports comparing features of each reproductive cell and explaining how traits of each help them perform their functions. • investigate codominance in livestock (e.g., shorthorn cattle). Design experiments to determine probability of different phenotypic expressions (e.g., coat color) in first and second generation offspring. Write lab reports detailing procedures and results to share with peers. ***Technology suggestion:*** *Use integrated software package to create tables and charts for analysis.* • research use of different breeding procedures in agricultural animals (e.g., horses, turkeys) and crops (e.g., corn). Write to breed associations to request information on disqualification of animals or plants for different breeds. Compare information from various associations. Interview livestock producers to determine traits for which they selectively breed. Investigate preferred plant traits in economically important crops. Research impact of selective breeding on agricultural animals and crops. Debate ethical and environmental implications of selective breeding. • demonstrate insemination process using female reproductive tracts acquired from biological supply houses or local slaughter houses. Identify different parts of female reproductive tracts. Identify appropriate insemination tools needed. Use tools to demonstrate insemination process, by placing dye solution in reproductive tract. Follow accepted procedures to dissect tracts to locate point where dye was deposited. Sketch reproductive tracts, identify parts, and describe steps of insemination process in lab reports. • survey local livestock producers to determine artificial insemination and embryo transfer techniques used. Investigate reasons for employing these techniques. Compare costs of semen and embryos from different breeders and examine reasons for cost differences. Write feature articles for agricultural journals explaining advantages and disadvantages of techniques *(WP - Transactive).*	Justin and Juanita have difficulty following directions. They are given instructions one day prior to assignment. They will be paired with peers to complete insemination procedures *(Types of extensions: time, motivation, environment, participation, demonstration of knowledge).*

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Scientific Ways of Thinking and Working Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**What are the processes of biological change?** How do agricultural crops and animals reflect diversity in nature?	**Students will** **Program of Studies** **Life Sciences** • examine how species change over time. • examine diversity and classification. **Scientific Inquiry** **All *Program of Studies* scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • analyze how science and technology are necessary for solving issues. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • identify functions of plant structures. • identify structural, physiological and behavioral characteristics of vertebrates and invertebrates. • relate fundamentals of genetics to organisms' morphology, physiology, and inheritance patterns.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • investigate history of domestication of economically important plants (e.g., wheat, corn, sugar cane). Create illustrated time lines to document milestones. ***Technology suggestion:*** *Use software to create time lines.* • create plant models, labeling, describing, and explaining each structure. Write children's books describing functions of plant parts *(WP - Transactive).* • examine plant cell structures with light microscopes. Create cell models, labeling basic cell structure (e.g., cell wall, cell membrane, nucleus, cytoplasm, chloroplast, vacuoles). Describe functions of cell structures on mechanical rather than biochemical level (e.g., nucleus and control of cell function, chloroplast and photosynthesis, mitochondria and respiration, cell membrane and transport). ***Technology suggestion:*** *Use light microscope or flex cams to examine cell structures.* • investigate plant defenses (e.g., poisons, thorns, hormones) and coevolution between plants and herbivores. Identify selective pressures acting on both herbivores and plants. Write news articles for agricultural journals explaining how plants reduce predation *(WP - Transactive).* • investigate irradiation on plant seeds to induce mutations and produce new varieties (e.g., peppers, soybeans, cotton, sugar cane, sunflowers, irises, roses, chrysanthemums, azaleas). Write articles about benefits and drawbacks of irradiation *(WP - Transactive).*	Willie and Ann understand cell structure and have participated in class discussions. They have difficulty manipulating objects and will work with small groups to produce models of cells *(Types of extensions: resources and materials, complexity, demonstration of knowledge).*

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Sample Activities	Sample Extensions for Diverse Learners
Students will • explore diversity among plants. Identify major highlights of plant evolution (e.g., vascular tissue) and impact on plant diversification. Identify divisions within plant kingdom and describe their characteristics and significant adaptations. Use graphic organizers to compare characteristics. Create bulletin boards, collages, or multimedia presentations on economic or medical importance of plants from each division, including local agricultural products. • compare monocot and dicot seeds. Place corn and bean seeds between wet blotters or paper towels and keep moist. Bisect and compare seeds after one day and after five days. Sketch, identify and label structures, and describe function of seed structures. • investigate evolution of various species (e.g., horses). Create murals depicting phylogenetic trees. Discuss how adaptations are advantageous to increased survival. • investigate early systems of classification (e.g., Aristotle). Compare Aristotle's system to that of Linnaeus. Create dichotomous keys for domestic plants and animals. Display in science lab. • examine differences between tamed and domesticated animals. Create collages, bulletin boards, or multimedia presentations for class members, explaining differences. Compare traits of wild and domesticated pigs. Identify traits that resulted from natural selection or selective breeding. Explain how wild pigs are adapted to their environment. Research history of breeds of livestock, including origin of animals, traits that were selected for through natural selection, traits that were selected for through selective breeding, and changes of breeds over time. Create illustrated histories of breeds to display at county fairs. ***Technology suggestion:*** *Use CD-ROMs, digital cameras, computers, video, and audio to create multimedia presentations.*	Bambi and Renee are interested in the domestication of certain animals. They finish their class assignment ahead of other students and develop short skits to share with the class on the domestication of cats and dogs *(Types of extensions: motivation, complexity, demonstration of learning).*

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Scientific Ways of Thinking and Working Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**How are organisms within ecosystems interdependent?** How do agricultural processes alter ecosystems? How are croplands different from natural ecosystems?	**Students will** **Life Sciences** • investigate cell regulation, differentiation, and how the process of photosynthesis provides a vital connection between the Sun and energy needs of living systems. • investigate the cycle of atoms and molecules within the biosphere. • analyze energy flow through ecosystems. • examine the factors that influence the interactions between organisms. • explore how human activities alter ecosystems. • recognize that living systems require energy. • analyze the flow of matter and energy. **Scientific Inquiry** **All *Program of Studies* scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • explore the impact of science on personal and community health. • recognize how science influences human population growth. • use science to analyze the use of natural resources. • investigate how science can be used to solve environmental quality problems. • use science to investigate hazards. • analyze how science and technology are necessary for solving issues. **Agri-biology Content Chart** • identify environmental factors that affect crop production. • identify physical properties and biological components of soils.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • investigate nitrogen cycle within biosphere. Examine nodules from roots of legumes (e.g., clover, alfalfa) under microscopes after staining with methylene blue. Sketch nitrogen-fixing bacteria. Write summaries in learning logs about importance of bacteria to nitrogen cycle. • investigate ways to change pH of soils. Interview agricultural extension agents to determine methods of changing pH. Analyze cost and efficacy of each method. Create how-to articles for agricultural publications *(WP - Transactive).* • design experiments to model processes that led to Dust Bowl of 1930s. Research soil conservation practices and techniques to prevent another Dust Bowl. Compare conservation practices and techniques of past with those of present in multimedia presentations. • investigate physical and chemical characteristics of ponds, springs, and rivers near agricultural cropland. Examine dissolved oxygen levels, turbidity, and bacterial growth. Compare data with students in other regions of Kentucky via Kentucky Water Watch Program. • investigate effects of pollutants (e.g., acid rain) on agricultural crops. Design and conduct investigations to measure acidity of rain water. Map Kentucky rain water acidity levels and compare crop loss due to pollutants with other Kentucky students. • investigate early and modern pesticides, comparing benefits of each. Debate effects of pesticides on beneficial organisms (e.g., soil invertebrates, insects, birds, mammals). Research pests (e.g., fungi, grasshoppers, corn borers) that damage major world crops. Research use of biological control of insects (e.g., ladybugs to control aphids). Produce articles for agriculturalists advocating biological control of pests (*WP - Transactive).* • investigate benefits and losses to crops due to recent weather patterns (e.g., floods, drought, wind, hail). Create collages of current news articles on agricultural impact by environmental forces. Research weather prediction techniques. Research current studies on causes of weather patterns (e.g., Arizona, 1998) and discuss validity of studies. Interview local agriculturalists to determine impact of economic losses due to weather. Write articles on impact weather has on agricultural crops and animals *(WP - Transactive).*	

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Scientific Ways of Thinking and Working, Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**How do organ systems work together to keep animals healthy?**	**Students will** **Life Science** • investigate cell structures and their functions. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • explore the impact of science on personal and community health. • use science to investigate hazards. • analyze how science and technology are necessary for solving issues. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • identify structural, physiological, and behavioral characteristics of vertebrates and invertebrates.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • identify and describe organs and organ systems and anatomical structures of important agricultural animals. List organs common to all and those that differ. Explain physiological functions of each structure. Research common diseases that affect each system and methods used to diagnose and treat diseases. Create brochures to be distributed at county extension offices that describe diseases and treatments (*WP - Transactive).*	

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Academic Expectations	Guiding Questions	Correlations to the Program of Studies
Scientific Ways of Thinking and Working, Patterns, Systems, Scale, and Models, Constancy and Change Over Time (2.1 - 2.6)	**What skills and knowledge must I have to be successful in an agricultural career in Kentucky?**	**Students will** **Life Sciences** • examine the factors that influence the interactions between organisms. **Scientific Inquiry** **All scientific inquiry bullets are included in this guiding question.** **Applications/Connections** • apply scientific inquiry and conceptual understandings to solving problems of technological design. • examine the interaction between science and technology. • explore the impact of science on personal and community health. • analyze how science and technology are necessary for solving issues. • analyze the role science plays in everyday life and compare different careers in science. • recognize that scientific knowledge is subject to change. • investigate advances that have effects on science and society. **Agri-biology Content Chart** • compare appropriate health programs for animal species. • identify major farm animal species, appropriate livestock enterprises, and their influence on world agriculture trends. • explore career opportunities and job qualifications in agri-biology. • integrate FFA Leadership activities.

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Sample Activities	Sample Extensions for Diverse Learners
Students will • examine contributions of livestock industry to society. Investigate use of animals and animal by-products in medical research and development of food products. Prepare multimedia presentations showing uses of animals and animal by-products. ***Technology suggestion:*** *Use CD-ROMs, digital cameras, computers, video, and audio to create multimedia presentations.* • investigate other issues of animal welfare (e.g., raising animals in confinement, animal health, management practices, continuous ingestion of antibiotics). Investigate role of food pyramid in determining proper diet selections for animals. Examine laws governing use of agricultural animals. Role-play public hearing between National Cattlemen's Association, United States Department of Agriculture official, People for the Ethical Treatment of Animals, and different types of vegetarians. Debate animal welfare issues. • search Internet for alternatives to Kentucky's tobacco crop. Investigate new and non-traditional crops as possible solutions. Research economic and social implications. Write letters to congressmen explaining results of research and recommendations for alternative crops *(WP - Transactive).* ***Technology suggestions:*** *Use Internet to conduct research. Use e-mail to communicate with congressmen.* • research scientific technologies (e.g., hydroponics, tissue culturing) that enhance agricultural endeavors. Create models of food supply systems using hydroponics and tissue culturing technology. Compare hydroponics method of growing crops to traditional methods. Debate advantages (e.g., reduction of labor costs) and disadvantages (e.g., disease introduction).	Teresa and Larry will create brochures to promote the introduction of new economic and agricultural crops for Kentucky. They will collaborate with agriculturalists (e.g., universities, colleges, county extension offices) to discover feasibiliy of their suggestions *(Types of extensions: motivation, complexity, demonstration of learning, resources and materials*).

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